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HELMET BODY STRUCTURE

[Herumetto no Bōtai Kōzō]

Satoshi SUZUKI et al.

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Inventor	:	Satochi SUZUKI, Kōyō HIRONO, Masayuki AKASAKA
Applicant	:	Yamaha Motor Co., Ltd.
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[Claims]

[Claim 1] In a helmet body made of synthetic resin on the inside of which are installed an impact-absorbing liner, a built-in cushion, and the like to configure a helmet, a helmet body structure characterized in that unidirectional fiber is arranged approximately parallel to edge portions along the edges of said body.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application] The present invention relates to the body structure of a helmet for the protection of the head, and more particularly, to the body structure of a helmet suitably worn when riding a motorcycle.

[0002]

[Prior Art] When riding a motorcycle, one has the obligation of wearing a helmet. As shown in Fig. 1, the helmet that is worn normally comprises a body 1 of a synthetic resin such as fiberglass-reinforced plastic (FRP), polycarbonate resin, ABS resin, or polypropylene resin to protect the interior from impact, an impact-absorbing liner 2 of styrofoam or the like to

[1] Numbers in the margin indicate pagination in the foreign text.

absorb shock received by helmet body 1, and internal cushions 3 fitting the helmet to the head, with straps 4 for securing the helmet to the head and a shield 5 covering the face that is attached to the helmet body.

[0003] Attempts have been made to reduce the weight of such a helmet to lessen the fatigue of the wearer and prevent the center of gravity from rising when wearing the helmet. In particular, in helmet bodies made of FRP, which is often employed in medium and high-end helmets, Kevlar (registered trade name) and Vinylon (registered trade name) fibers are blended in to reduce weight.

[0004] Conventionally, a structure in which glass mats are locally positioned for reinforcement behind spots that tend to be damaged on body 1 has been adopted to improve the impact resistance of such helmets. The glass mats thus employed have the same specifications as the glass mats that have been conventionally employed as the base material of the laminate body constituting the helmet; that is, they consist of straight glass fibers of fixed length (about 5 cm) that are randomly dispersed in sheets formed with polyester resin binder that are cut to suitable size.

[0005]

[Problem to Be Solved by the Invention] However, a strength test conducted by the present applicants on helmets worn when riding motorcycles revealed that extremely large tensile stress is applied along a narrow area along the edge portions such as the lower edge and the edge of the window opening of the helmet by impact applied along the forehead and around the bottom portions of the helmet. In helmet bodies in which conventional glass fiber is dispersed in random fashion so that the reinforcement direction is nearly uniform, even when locally reinforced with glass mats such as those set forth above, cracks develop at right angles to the edge portions, and as would be expected, shock is no longer absorbed.

[0006] Accordingly, to ensure adequate strength around edge portions at which such substantial tensile stress is applied, one response is to employ multiple conventional reinforcing glass mats in such spots in thickly overlapping fashion. However, when these glass mats are overlapped several sheets deep at such spots, there are problems in that the overall weight of the helmet increases, the wearer tends to grow tired, and the center of gravity is raised.

[0007] The present invention has for its object to eliminate such drawbacks of conventional helmet cap bodies, and more specifically, has for its object to reduce the weight of the

helmet body by positioning unidirectional fibers in a direction approximately parallel to edge portions around the perimeter that require reinforcement so that impact resistance can be maintained that is equivalent to employing several stacked glass mats for reinforcement.

[0008]

[Means of Solving the Problem] To solve the above-stated problem and achieve the above-stated goal, in the present invention, in a body made of synthetic resin on the inside of which are installed an impact-absorbing liner, a built-in cushion, and the like to configure a helmet, the helmet body structure is characterized in that unidirectional fiber is arranged approximately parallel to edge portions around the edge of the body.

[0009]

[Operation] The operation of the body of the helmet of the present invention having the structure set forth above will be described. For example, when a large shock is applied to the forehead portion or the lower edge of the helmet and the edge of the window opening, lower edge, and other edge portions of the helmet deform inward as a result, substantial tensile stress is applied along the each of the edge portions in a narrow area on the inside along the edge portions. When that occurs, since the

unidirectional fiber positioned along the edge portions is roughly aligned with the direction of tension of the tensile stress, even heavy tensile stress can be effectively resisted, damage to the helmet body can be prevented, and the impact can be absorbed.

[0010]

[Embodiments] Embodiments of the present invention are described below based on the drawings. An embodiment of the body structure of the helmet of the present invention will first be described based on Figs. 2 and 3.

[0011] Figs. 2 and 3 show how sheets of unidirectional fiber are arranged when bonded on the interior surface of body 1. Fig. 2 shows how sheets of unidirectional fiber are arranged when body 1 is viewed from the side, and Fig. 3 shows how sheets of unidirectional fiber are arranged when body 1 is viewed from the front (left half of the drawing) and back (right half of the drawing).

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[0012] As shown in the figure, sheets 21, 22, 23, and 24 - formed by cutting to suitable size unidirectional fiber sheets in which straight, long inorganic fibers (glass fiber) are aligned and joined in mutually parallel fashion - are locally arranged and integrally adhered on the inside surface of body 1

along the edge portions of window 11, lower edge 12, and back edge 13, so that the fibers are roughly parallel with the various edge portions of body 1.

[0013] The unidirectional fiber sheets thus employed are formed by continuously bundling straight, long inorganic fibers in groups of 50 to 4,000 glass fibers about 11 microns in diameter with organic fiber (polyamide fiber, polyester fiber, and the like) filaments into sheets (about 0.47 mm in thickness).

[0014] Compared to helmets in which glass mats in the form of conventional glass fiber dispersed in random fashion and formed into sheets with polyester resin binder are partially adhered to the helmet body, since the reinforcement material that is adhered in the present embodiment differs from conventional glass mats only by comprising unidirectional fiber, it can be applied to the helmet body by the same methods as when reinforcing with conventional glass mats. Further, employing just one sheet of unidirectional fiber in each spot results in reinforcement rivaling the stacking of multiple sheets of conventional glass mats in each spot.

[0015] Other embodiments of the present invention in which unidirectional fiber sheets such as those set forth above are not adhered as individual sheets but are incorporated as part of a laminate structure constituting the helmet body itself when

arranging unidirectional fiber in the helmet body will be described next based on Figs. 4 to 9.

[0016] A conventional helmet body structure, for example, moving from the outside in, consists of a laminate structure in which (1) a glass mat (0.6 mm), (2) clothlike members (three sheets x 0.46 mm) of polyvinyl alcohol fiber, polyethylene fiber, or some other organic fiber, (3) and a glass mat (0.6 mm) are stacked. As needed, multiple reinforcing glass mats are stacked and locally adhered on the inside surface, after which the laminate structure is impregnated with a liquid matrix resin (polyester resin, vinyl ester resin, or the like). Heat is applied in a mold to solidify the materials into the helmet body shape, and the surface is sometimes painted (0.3 mm). (This yields a total thickness of 2.88 mm).

[0017] By contrast, in the present embodiment, the laminate structure of the helmet body that is solidified by applying heat in a mold after impregnation with a liquid matrix resin (polyester resin, vinyl ester resin, or the like), from the outside in, consists of (1) glass mat (0.6 mm), (2) unidirectional fiber sheet (0.47 mm), (3) clothlike members (two sheets x 0.46 mm) of polyvinyl alcohol fiber, polyethylene fiber, or some other organic fiber, and (4) unidirectional fiber sheet (0.47 mm) that are stacked, with an outer surface paint

layer (0.3 mm being applied). (This yields a total thickness of 2.76 mm).

[0018] As shown in Figs. 4 and 5, in the helmet body of the above-described embodiment consisting of a laminate structure, the unidirectional fiber is arranged as unidirectional fiber sheets 25 and 26 in the manner of (4) above on the inside surface of the helmet body along the edge portions of window 11, lower edge 12, and rear edge 13 so that the direction of the fibers is aligned with the various edge portions.

[0019] In the arrangement of unidirectional fiber sheets 25 and 26 in the laminate structure of a helmet body as set forth above, the layered unidirectional fiber sheets are preformed as individual blanks 25 and 26 as shown in Figs. 6(A) and (B). The cuts 28, 28, 28, and 28 shown in Fig. 6(A) are made in blank 25 positioned on the top of the head portion of the helmet body. In the course of solidifying the shape of the helmet body in the mold, the areas of the cuts facilitate stacking alignment, enhancing three-dimensionally solidification by conforming blank 25 to the shape of the helmet body in the mold. During this process, the portions extending from the edge portions of the body of the blank are removed by trimming following solidification of the shape of the helmet body.

[0020] With regard to impact resistance, in the fiber direction shown in Figs. 4 and 5, it is effective to arrange unidirectional fiber sheets 25 and 26 on the very inside of helmet body 1. However, in the present embodiment, in consideration of resistance to penetration (the function of preventing objects from penetrating into the interior of the helmet), in addition to unidirectional sheets 25 and 26 arranged on the very inside of helmet body 1, as shown in Figs. 7 and 8, a separate unidirectional fiber sheet 27 positioned at 90° to the fiber direction of unidirectional fiber sheet 25 is positioned by stacking below the glass mat layer on the outside surface of the helmet body.

[0021] When arranging unidirectional fiber sheet 27 in the laminate structure of the helmet body with a fiber orientation differing by 90°, just as in the case of unidirectional fiber sheet 25, a blank 27 such as that shown in Fig. 9 can be formed, and cuts 29, 29, 29, and 29 can be provided in blank 27.

[0022] In this manner, two layers consisting of unidirectional fiber sheets 25 and 27 with fiber orientations differing by 90° can be arranged by stacking so that the overall unidirectional fiber buried in the helmet body forms a lattice. This solves the problem of decreased resistance to penetration due to weak

points when only the layer of unidirectional sheet 25 is provided.

[0023] Although the helmet body structure of the present invention has been described above based on various embodiments, the present invention is not limited to such embodiments alone, and covers various implementation modes falling within the scope of the description of the claims.

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[0024] For example, the present inventors have already proposed a technique of inserting a flexible clothlike member between the helmet body and the impact-absorbing liner to increase the resistance to penetration of the helmet (Japanese Patent Application Publication No. Hei 4-112392). Applying such a technique to above-described Embodiment 2 permits the omission of the layer of unidirectional fiber differing in fiber orientation by 90° positioned beneath the glass mat layer on the outside of the helmet body.

[0025]

[Effect of the Invention] The helmet body structure of the present invention as set forth above permits a lightening of the helmet body while maintaining the same impact resistance as when employing multiple stacked sheets of reinforcing glass mats by

simply positioning unidirectional fibers along the edge of the helmet body.

[Brief Description of the Figures]

[Fig. 1] A sectional view of a conventionally known helmet applying the helmet body structure of the present invention.

[Fig. 2] A drawing showing a side view of the arrangement of unidirectional fibers in an embodiment of the helmet body structure of the present invention.

[Fig. 3] A drawing showing front and rear views (front view on the left and rear view on the right in the figure) of the arrangement of unidirectional fibers in the embodiment of Fig. 2.

[Fig. 4] A drawing showing a side view of the arrangement of unidirectional fiber in another embodiment of the helmet body structure of the present invention.

[Fig. 5] A drawing showing front and rear views (front view on the left and rear view on the right in the figure) of the arrangement of unidirectional fibers in the further embodiment shown in Fig. 4.

[Fig. 6] A drawing showing blanks (A) and (B) of unidirectional sheets employed in the further embodiment shown in Fig. 4.

[Fig. 7] A drawing showing a side view of the arrangement of unidirectional fibers with a fiber orientation differing by 90°

additionally employed to prevent a decrease in resistance to penetration in the further embodiment shown in Fig. 4.

[Fig. 8] A drawing showing front and rear views (front view on the left and rear view on the right in the figure) of the arrangement of unidirectional fibers with a fiber orientation differing by 90° shown in Fig. 4.

[Fig. 9] A drawing showing the blank of a unidirectional sheet with a fiber orientation differing by 90° additionally employed in the further embodiment shown in Fig. 4.

[Key to the Numerals]

1 Helmet body

21 Unidirectional fiber

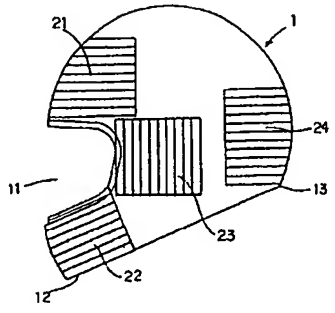
22 Unidirectional fiber

23 Unidirectional fiber

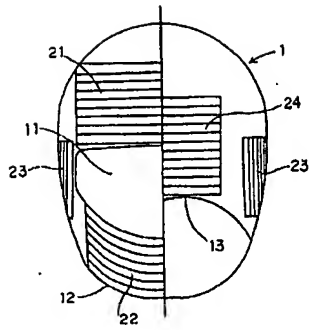
24 Unidirectional fiber

25 Unidirectional fiber

26 Unidirectional fiber



[Fig. 2]



[Fig. 3]

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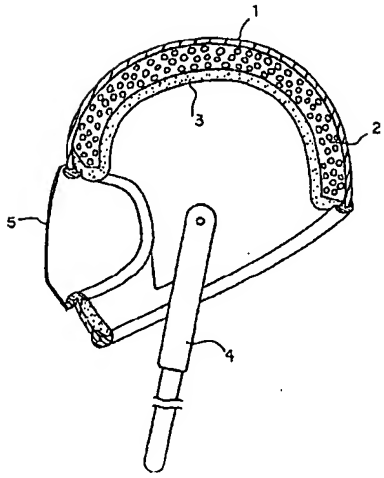
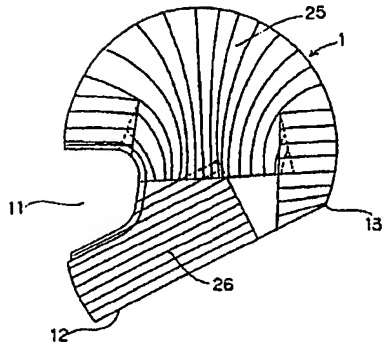
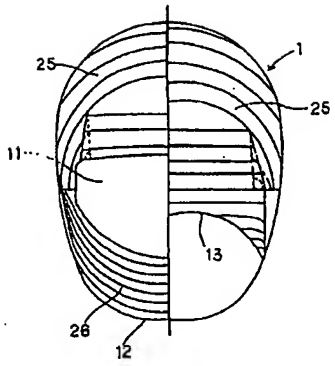


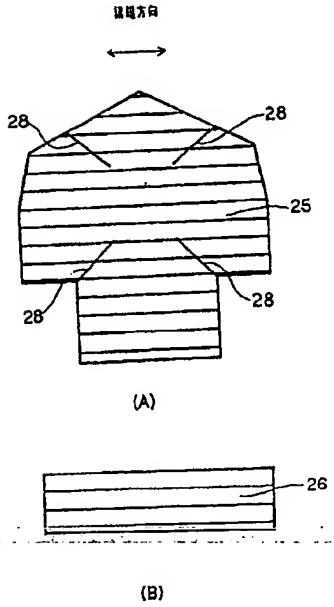
[Fig. 1]



[Fig. 4]

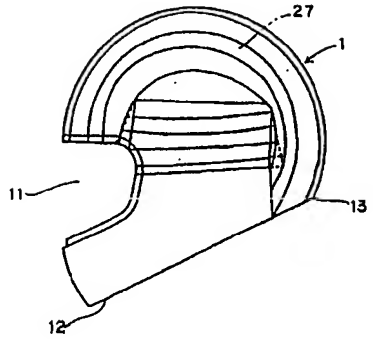


[Fig. 5]

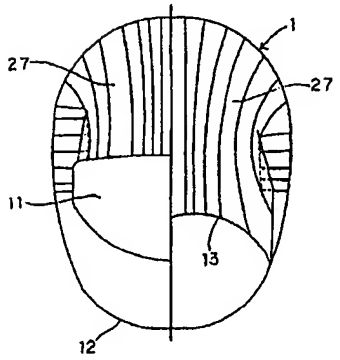


[Fig. 6]

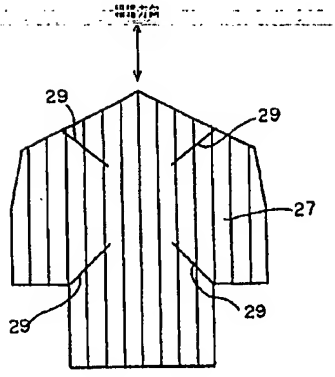
[Fiber orientation]



[Fig. 7]



[Fig. 8]



[Fig. 9]

[Fiber orientation]